RATE OF SECONDARY INFERTILITY IN PATIENTS AFTER CESAREAN SECTION VERSUS NORMAL VAGINAL DELIVERY

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ABSTRACT

Background: Rising rates of secondary infertility may be linked to increased rates of Caesarean sections. Caesarean sections can result in reproductive morbidity due to scar defects, vascular adhesions, tubal pathology, and other long-term complications that may hinder reproductive capacity.

Objective: To compare the frequency of secondary infertility-associated reproductive tract abnormalities among women with previous cesarean section versus previous vaginal delivery presenting to a tertiary care infertility clinic.

Methods: This observational cross-sectional study was conducted at Hayatabad Medical Complex Peshawar, Department of Gynecology and Obstetrics from May 6, 2025, to November 5, 2025. A total of 190 women with secondary infertility were recruited through non-probability consecutive sampling. A total of 190 women with secondary infertility were enrolled through non-probability consecutive sampling, with 95 participants in each group based on previous mode of delivery.

Results: Caesar section had a higher frequency of secondary infertility 71.6% when compared to vaginal delivery 44.2% with a p value of 0.001. Cesarean scar niche was present in 53.7% of women with a previous Cesarean delivery. Unilateral blockage 22.6% Vs 10.5%, bilateral blockage 19% vs 6.6% were noted in the Cesarean group.

Conclusion: The women with a past Cesarean section had a higher incidence of secondary infertility which could be explained by secondary structural changes due to surgery and tubal pathology. This becomes even more important when considering a Cesarean delivery to assist in making decisions and when considering a more urgent fertility workup when indicated.

Keywords: Secondary infertility; Cesarean section; Vaginal delivery; Cesarean scar defect; Tubal pathology; Reproductive outcomes.

INTRODUCTION

Secondary infertility describes complications concerning the ability to conceive or carry a pregnancy to term following a live birth [1]. This growing phenomenon is frivolously tackled within the public domain, and social, psychological, and economic consequences are certainly to follow.

The World Health Organization acknowledges infertility as a disease and predicts a large portion of the global population to experience some form of infertility throughout their reproductive lifetime [2]. Primary and secondary infertility has been suggested as a public health concern, and the means of deliveries has been studied as a variable linked to subsequent infertility. More specifically, there is a hypothesis that Cesarean deliveries can mechanically and biologically affect the ability to conceive [3].

The body of evidence points to a modest influence of prior cesarean section (CS) delivery on subsequent conception and birth rates as compared to prior vaginal delivery (VD). Approximately 9% of women with prior CS were less likely to get pregnant and 11% were less likely to subsequently give birth as compared to those who delivered vaginally [4]. This correlation is supported by a prospective cohort from the multi-center First Baby Study which documented lesser births and lower rates of recorded pregnancies (CS Adjusted HR 0.85)

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within three years post first CS compared to those with vaginal deliveries.[5]

Potential mechanisms include the formation of pelvic adhesions, infections (enteric, abdominal, or wound), damages to the tubes from surgical procedures, and the formation of cesarean-scar defects (isthmocele or niche), which can obstruct and impair the transport of sperm, implantation, or embryo transfer during assisted reproduction[6]. More recent systematic reviews and meta-analysis of both assisted reproduction outcomes and natural conception suggest that a prior cesarean section may lead to a clinically significant reduced rate of pregnancy, live birth, and possibly increased complexity of embryo transfer. These epidemiological patterns of outcomes give evidence of biological plausibility.[7,8]

With a reasonable body of evidence, the ability to draw conclusions is limited by the diversity of the studies, remaining confounding (particularly by indication), and inconsistent definitions of infertility. Some studies of high caliber and quality, after adjusting for confounding factors, report these outcomes to be smaller or even null; others, in contrast, report outcomes of significant clinical importance.[9,10] The high global rates of cesarean births and economic and social burdens of infertility highlight the imperative need for well-structured comparative studies that precisely estimate the incidence of secondary infertility occurring after cesarean as opposed to vaginal births. This study aims to estimate and compare the incidence of secondary infertility following cesarean and vaginal births in our population and try to identify\ estimate some factors that may be responsible for having such effects.

MATERIAL AND METHODS

This analytical cross-sectional study was conducted at the Department of Obstetrics and Gynaecology at Hayatabad Medical Complex (HMC) in Peshawar. The data collection period spanned six months, from May 5, 2025, to November 5, 2025.

Total 190 women's were enrolled. The sample size was computed to compare two proportions, where 95 women were assigned to each group (n=190). The participants were recruited into Group A (past cesarean section) and Group B (past vaginal delivery) in 1:1 ratio. The study period involved non-probability consecutive sampling of recruitment until the required sample size was reached.

The study population included women of reproductive age, 18 to 40 years, who presented with complaints of secondary infertility. Secondary infertility was outlined as the inability to achieve any clinical pregnancies following any live birth over the span of 12 months of consistent and unprotected sexual intercourse. In order to improve the risk assessment for the gestational period, the inclusion criteria made it so that the woman's only birth instance was at least two years ahead of the study enrollment date.

In order to eliminate confounding variables, the study added inclusion criteria such as no history of primary infertility, no history of uterine or tubal surgeries other than the index Cesarean, and no diagnosis of male factor infertility as defined by abnormal semen parameters according to World Health Organization criteria. The other exclusion criteria included women with diabetes, other relevant comorbidities, a documented history of pelvic inflammatory illness, or endometriosis.

A face-to-face interview method was used to collect data using a structured, pre-designed study proforma developed specifically for this study after review of the relevant literature and study objectives. This tool was used to collect data pertaining to the respondents' socio-demographic characteristics, as well as their obstetric and gynecological history, type, and date of the last delivery, length of the current episode of infertility, menstrual history, and any other pertinent medical and/or surgical history.

All participants of the study were entered into the study with the understanding of receiving a secondary infertility workup as per the study's objectives. The secondary infertility assessment started with a transvaginal pelvic ultrasound. This technique was employed to examine the participants' uterine structure and lining as well as the ovaries. Also, and especially in participants of Group A, the assessment sought the absence or type of niche or defect within the Cesarean section scar. Additional studies, such as Hysterosalpingography (HSG) to check for tubal permeability, and/or diagnostic laparoscopy were governed by standard hospital protocols along with appropriate clinical indications, and their results were noted for later evaluation.

To standardize diagnosis results, cesarean scar niche was determined on transvaginal ultrasound as an anechoic triangular or semicircular defect at the location of the former lower uterine segment cesarean scar with measurable depth into the myometrium. On

hysterosalpingography, tubal blockage was determined as the inability of contrast spillage through the fallopian tube(s), either unilateral or bilateral depending on the affected side. The definition of hydrosalpinx included distal occlusion of the fallopian tube with a dilated contrast-filled tube on HSG. Bilateral patency of tubes was established as the free spillage of contrast in each tube in the peritoneal cavity.

The results of the data were analyzed using the data analysis software of SPSS 25.0. The study groups' demographic and clinical data were summarized using descriptive statistics and then analyzed to derive means, standard deviations, counts, and proportions. The primary outcome, the rate of secondary infertility, was subsequently analyzed and compared between the experimental (Cesarean) and control (Normal Vaginal Delivery) groups using Chi-square analysis. A p value of 0.05 signified statistical significance was the criterion value for the study.

Ethical approval was obtained and IERB of Hayatabad Medical Complex, Peshawar, approved the study in full along with the study conducted and the consent form, before any research or associated activities were initiated. The participant in this study gave written consent after being fully informed about the purpose of the study, how it would be carried out, its advantages and disadvantages, and the steps that would be taken to guarantee the confidentiality of the data collected.

RESULTS

Age of the participants in Group A was on average 30.4 ± 4.1, whereas in Group B it was 29.8 ± 3.9 (p=0.312). The average period of infertility was 3.5 ± 1.2 years in the cesarean group and 3.3 ± 1.4 years in the vaginal delivery group (p=0.287). Mean differences with 95% confidence intervals are also presented in Table 1.

Table 1: Baseline Characteristics of the Study Participants

Characteristic	Group A	Group B	Mean Difference (95% CI)	p-value
Age (years), Mean ± SD	30.4 ± 4.1	29.8 ± 3.9	0.60 (-0.54 to 1.74)	0.312
Duration of infertility (years), Mean ± SD	3.5 ± 1.2	3.3 ± 1.4	0.20 (-0.17 to 0.57)	0.287
Time since last delivery (years), Mean ± SD	4.8 ± 1.5	4.5 ± 1.7	0.30 (-0.16 to 0.76)	0.189
BMI (kg/m²), Mean ± SD	26.5 ± 3.2	25.9 ± 3.5	0.60 (-0.35 to 1.55)	0.225

Women with a history of cesarean sections experienced secondary infertility at a higher rate than those who had a vaginal birth. In Group A, 68 of the 95 women (71.6%) were identified with secondary infertility with no other cause; whereas, in Group B, 42 of the 95 women (44.2%) had the same infertility. This difference in secondary infertility was statistically significant (p<0.001), thus a strong correlation was identified between having had a cesarean section and infertility thereafter. The odds of secondary infertility-related findings were significantly higher in women with previous cesarean section (OR 3.18; 95% CI: 1.74–5.80). (Table 2).

Table 2: Comparison of Secondary Infertility by Mode of Previous Delivery

Group	Women with Secondary Infertility n (%)	OR (95% CI)	p-value
Group A	68 (71.6%)	3.18 (1.74–5.80)	<0.001
Group B	42 (44.2%)	Reference	
Total	**110 (57.9%)**		

During imaging via transvaginal ultrasound, a cesarean scar niche was recognized in 51 women (53.7%, Group A), whereas none were noted in Group B (p < 0.001). Of the participants who underwent hysterosalpingography (HSG), women with prior cesarean section had significantly less bilateral tubal patency, in comparison to their counterparts who had prior vaginal delivery (52.4% versus 73.7%,

p=0.004). On the other hand, the cesarean group had a higher rate of obstruction of both or unilateral of the fallopian tubes, when compared to the vaginal delivery group (19%, 22.6% vs 6.6%, 10.5%, respectively; p=0.009, p=0.035). Of the subset of women that underwent laparoscopy, pelvic adhesions, as detected, were also more prevalent within the cesarean group. Odds ratios with 95% confidence intervals for diagnostic findings are also presented in Table 3.

Table 3: Findings of Diagnostic Investigations

Investigation / Finding	Group A	Group B	OR (95% CI)	p-value
Cesarean scar niche (USG)	51 (53.7%)	0 (0%)	Not estimable*	<0.001
Hysterosalpingography (HSG)				
• Bilateral tubal patency	44 (52.4%)	56 (73.7%)	0.39 (0.20–0.76)	0.004
• Unilateral tubal blockage	19 (22.6%)	8 (10.5%)	2.48 (1.02–6.05)	0.035
• Bilateral tubal blockage	16 (19.0%)	5 (6.6%)	3.34 (1.16–9.61)	0.009
• Hydrosalpinx	5 (6.0%)	2 (2.6%)	2.35 (0.44–12.44)	0.302

DISCUSSION

In this study, we found women with past C-sections (71.6%) had higher rates of secondary infertility when compared to women with past vaginal deliveries (44.2%). This association may match some previous research, yet the difference in magnitude and context is considerable enough to warrant further explanation.

In the meta-analysis by Sima et al, there was a 9% decline in the rate of subsequent pregnancies and an 11% decline in subsequent births following cesarean deliveries versus vaginal deliveries (risk ratio [RR] 0.91)[11]. However, while our effect size was greater than theirs, their conclusion that prior cesarean section may reduce subsequent fertility is supportive of our findings. They also noted that while this was an observational design, other factors such as study confounding and design varied and limited causal inferences were made to explain the relationship.

Another relevant systematic review within reproduction and assisted reproductive technologies (ART) by Wang et al, illustrated that women with prior cesarean sections had a clinically meaningful decrease in clinical pregnancy rates (9%), live birth rates (13%), implantation rates (11%), and had much higher difficulty with embryo transfers in ART[12]. Although ART is different from our study population (general infertility post-delivery), the effect direction is the same and thus support the biological rationale that cesarean sections may affect further fecundity negatively in women.

Mechanistically, the uterine niche, cesarean scar niche, has been suggested as one mechanism explaining the impairment of fertility after a Cesarean delivery, Vissers et al reviewed the impact of the Cesarean scar niche on fertility in detail[13]. Our data found the scar niche in over 50% of the cesarean group, thus corroborating this mechanism. Tower et al found women with uterine scar defects had an absolute pregnancy rate of ~58.7% (95% CI 59.03-82.48) after a cesarean which again speaks to the decrease in fertility in this cohort [14]. There are plausible pathophysiologic mechanisms that may explain these menstrual debris and fluid accumulation, bacterial colonization, compromised endometrial function, and obstruction of sperm/embryo transport[15].

Our study adds to this literature by coupling a quite frequently observed secondary infertility together with structural findings (scar niche, tubal blockage) in the cesarean group: for example, bilateral tubal blockage was significantly more common in the cesarean group (19% vs 6.6% p=0.009). Such findings are similar to the observational report by Tran et al where, among women with prior cesarean section and secondary infertility, 60.4% had detectable scar defects and bacterial colonization at those defects[16]. This substantiates the case for a mixed mechanism of anatomical disruption (scar/niche) and infection/adhesion causing impairment to fertility.

However, existing evidence reveals discrepancies that should be taken into consideration[17]. For example, Hsu et al found

no evidence of a difference in subsequent infertility between cesarean and vaginal delivery in their cohort study[18]. This suggests that there may be effect modification at play that could be due to variation in study population, clinical indications for cesarean, intended fertility outcomes, and methods used to assess infertility[19]. Furthermore, Gewida et al stated that larger studies with lower quality have greater effect size, which suggests unmeasured confounding factors or residual bias[20]. It is plausible that our study at a single tertiary center in Peshawar has some unmeasured confounding factors (e.g. postoperative infection, access to fertility services) that could exacerbate the observational hypothesis.

What sets our study apart is the methodological strength in comparing two distinct modality of delivery along with additional structural investigations (ultrasound angio-niche mapping, HSG tubal study). There are certain limitations which needs to be addressed, including a single tertiary care center with a modest sample size over a fixed study period, which may limit the generalizability of the findings. In addition, the use of non-probability consecutive sampling may have introduced selection bias., potential selection bias (i.e., women seeking care during the infertility), and the inability to control for several confounders, such as pre-existing pelvic infection, socioeconomic status, and the male partner's fertility status, which may also be relevant. Future projected cohort studies that take further variables into account would serve to establish and clarify the relationship further.

CONCLUSION

Secondary infertility was significantly more common among women with a previous Cesarean section compared to those with a prior vaginal delivery, as this study found. Prior Cesarean sections and tubal pathology showed a higher than normal frequency of Cesarean scar defects, implying that postoperative changes in the reproductive tract can lead to reduced fertility. These findings highlight the need for careful consideration of the mode of delivery as well as prompt fertility assessment in women with a history of Cesarean section who subsequently present with secondary infertility.

Authors' Contribution

Andaleeb Farooq Nawaz: Conceptualization, study design, supervision, and manuscript review.
Shagufta Naz: Data analysis, manuscript drafting, study design, and correspondence.
Bibi Maryam: Literature review, data interpretation, and manuscript assistance.
Sameia: Data collection and manuscript assistance.
Fayyaz Ullah: Statistical support, critical review, and editing.
Wajeeha Farooq: Literature search, manuscript review, formatting, and proofreading.
All authors made substantial contributions to the work, critically reviewed and approved the final version of the manuscript, and agree to be accountable for all aspects of the work.

Conflict of Interest

The authors declared no conflict of interest.

Acknowledgment

We would like to acknowledge the staff of the Department of Obstetrics and Gynaecology, Hayatabad Medical Complex, Peshawar, for their support during data collection and facilitation of this study. We are also thankful to all participating women for their cooperation.

Funding Disclosure

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethical Approval

Ethical approval for this study was obtained from the Institutional Ethical Review Board (IERB), Hayatabad Medical Complex, Peshawar, prior to initiation of data collection (Ref # 140, dated 2-5-2025).

Informed Consent

Written informed consent was obtained from all participants before enrollment in the study.

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